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**Title:**

**MEDIA REGISTRATION MECHANISM FOR IMAGE FORMING DEVICE**

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## **MEDIA REGISTRATION MECHANISM FOR IMAGE FORMING DEVICE**

### **Background**

[0001] In some image forming devices, media registration mechanisms have been incorporated into the media path in order to help align an edge of a sheet of print media (hereinafter referred to as “print media”). Aligning the print media helps to orient it in a consistent position for imaging or outputting.

[0002] In prior media registration mechanisms, moving belts were angled towards a registration fence to achieve media registration. When the print media came into contact with the angled belts, the print media was carried into and against the fence.

[0003] In other image forming devices, vacuum rotor technology has been used to orient the print media in a consistent position for imaging or outputting. Vacuum rotor technology uses vacuum suction cups to grab print media from one imaging station, swing the print media about an arc to the next imaging station, and then drop off the print media to the next imaging station.

### **Brief Description Of The Drawings**

[0004] In the accompanying drawings which are incorporated in and constitute a part of the specification, embodiments of a mechanism and method are illustrated which, together with the detailed description given below, serve to describe example embodiments of the mechanism and method. It will be appreciated that the illustrated boundaries of elements (e.g., boxes or groups of boxes) in the figures represent one example of the boundaries. One of ordinary skill in the art will appreciate that one element may be designed as multiple elements or that multiple elements may be designed as one element. An element shown as an internal component of another element may be implemented as an external component and vice versa.

[0005] Further, in the accompanying drawings and description that follow, like parts are indicated throughout the drawings and description with the same reference numerals, respectively. The figures are not drawn to scale and the proportions of certain parts have been exaggerated for convenience of illustration.

[0006] **Figure 1** is a diagram of one embodiment of an image forming device **100**;

[0007] **Figure 2** is a top view of one embodiment of a media registration mechanism **200**;

[0008] **Figure 3** is a top view of another embodiment of a media registration mechanism **300**;

[0009] **Figure 4** illustrates one embodiment of a methodology for media registration;

[0010] **Figure 5** illustrates another embodiment of a methodology associated with moving print media along a media path in an image forming device; and

[0011] **Figures 6A-6E** illustrate one embodiment of an media registration sequence.

#### Detailed Description Of Illustrated Embodiments

[0012] Illustrated in **Figure 1** is one embodiment of an image forming device **100**. The image forming device **100** may be a printing device such as a liquid electrophotographic printer, a laser printer, an inkjet printer, a copier, an all-in-one product, a multifunctional peripheral (MFP) device, or other type of imaging device that forms an image onto print media. In this embodiment, the image forming device **100** may include a media handling mechanism, such as a media feeder **105**, configured to supply sheets of print media to a media registration mechanism **110** from an input position. The registration mechanism **110** is configured to align the print media prior to imaging. In one embodiment, the registration mechanism **110** is configured to substantially align an edge of the print media against a registration wall so that each sheet of print media is in a relatively consistent position and orientation for imaging. The registered print media is then advanced to an image forming mechanism **115** where an image is formed onto the print media. The image forming device **100** may include one or more media paths along which the print media is carried.

[0013] The image forming mechanism **115** may be embodied in a variety of different ways depending on the type of image forming device **100**. For example, the image forming mechanism **115** may include a liquid electrophotographic mechanism, a laser imaging mechanism, an inkjet mechanism, a thermal printing mechanism, a digital image reproduction mechanism, or other type of printing mechanism. Once the print media is imaged by the image forming mechanism **115**, the print media is moved along a path to an output **120**. The output **120** may be one or more output trays or other devices from which a user can receive the imaged print media.

[0014] Illustrated in **Figure 2** is a top view of one embodiment of a media registration mechanism **200** or media steering mechanism. The media registration mechanism **200** includes a registration or alignment wall **205**, or fence, that defines a reference axis **A**. The registration wall **205** is configured to assist in the process of positioning and orienting print media prior to imaging. For example, as print media is carried along a media path, represented by arrow **B**, an edge of the print media is substantially aligned against the registration wall **205** before the print media is fed to the image forming mechanism (not shown). In this manner, multiple sheets of print media can be substantially aligned in a consistent position and orientation. By aligning the print media, an image can be formed at a generally consistent location on the print media relative to the reference axis **A**.

[0015] With further reference to **Figure 2**, in one embodiment, the media registration mechanism **200** can include multiple media carriers that carry print media along the media path **B**. In one embodiment, a first media carrier can be a first transport belt **210** and a second media carrier can be a second transport belt **215**. It will be appreciated that other types of media carriers may be used instead of belts such as nipped rollers, vacuum assisted belt, or an electrostatically charged web. In one embodiment, both the first and second belts **210**, **215** are positioned substantially parallel to each other and the registration wall **205**. For example, the first belt **210** can be positioned between the second belt **215** and the registration wall **205** such that the first belt **210** is adjacent to the registration wall **205** while the second belt **215** is adjacent to the first belt **210**. In other words, the second belt **215** is offset or spaced a greater distance away from the registration wall **205** than the first belt **210**.

[0016] The first belt **210** can be configured to engage the print media and move or otherwise carry it in a linear direction along the media path **B** at a first speed or velocity. The

second belt **215** is also configured to engage the print media and simultaneously move it in a linear direction along the media path **B** at a second speed. In one embodiment, the first speed of the first belt **210**, represented by arrow **C**, is less than the second speed of the second belt **215**, represented by arrow **D** (which is longer than arrow **C** to illustrate the difference in speeds). With the different speeds, upon concurrently engaging the print media, the first belt **210** moving at the first speed and the second belt **215** simultaneously moving at the second speed causes the print media to rotate towards the registration wall **205** until an edge or side of the print media is substantially aligned against the registration wall **205**. In other words, because of the difference in relative speeds between the first and second belts **210**, **215** (where the first belt **210** travels slower than the second belt **215**), the print media is steered towards the registration wall **205**. One example of an alignment process will be described with reference to **Figures 6A-6E**.

[0017] To drive the first and second belts **210**, **215** at different speeds, the media registration mechanism **200** may further include drive means coupled to the first and second belts **210**, **215**. In one embodiment, the drive means can include a drive mechanism **220** comprising a motor **225** coupled to a drive shaft **230**. The drive shaft **230** can include a first diameter portion **235** and a second diameter portion **240** that is larger than the first diameter portion **235**. In one embodiment, the first and second diameter portions **235**, **240** may comprise lobes that project radially from the drive shaft **230** to create the different diameter portions. Of course, the basic diameter of the drive shaft **230** can serve as the first diameter portion **235** and a lobe having a larger diameter than the basic diameter of the drive shaft **230** can serve as the second diameter portion **240**. In another embodiment, the drive shaft **230** may be a single diameter shaft having pulleys or gears of different diameters disposed thereon to achieve the same or similar effect.

[0018] In another embodiment, the drive means may include two motors to independently drive the first and second belts **210**, **215** at different speeds. It will be appreciated that other types of drive means may be used including any mechanical, electromechanical, electromagnetic components, or combinations thereof to drive the first and second belts **210**, **215** at different speeds.

[0019] To transfer rotational movement of the drive shaft **230** to the first belt **210**, the first belt **210** is drivingly engaged with the first diameter portion **235** of the drive shaft **230**.

Likewise, the second belt **215** is drivingly engaged with the second diameter portion **240** to transfer rotational movement of the drive shaft **230** to the second belt **215**. In one embodiment, the linear speeds of the first and second belts **210**, **215** can be the product of an angular speed of the drive shaft **230** multiplied by the radius of the first and second diameter portions **235**, **240**, respectively. Accordingly, when the drive shaft **230** is driven at one angular speed, the first and second belts **210**, **215** are driven at different linear speeds since the first and second diameter portions **235**, **240**, respectively, of the drive shaft **230** have different radii. Thus, when the drive shaft **230** is rotated, the first belt **210** travels at the first speed and the second belt **215** travels at the second speed (which is greater than the first speed of the first belt **210**). Of course, different relationships between the first and second speeds of the belts **210**, **215** can be used.

[0020] As a sheet of print media comes into contact with the first and second belts **210**, **215**, the print media is carried along the media path **B**. However, the difference in speeds causes the print media to rotate and move towards the slower belt and, hence, towards the registration wall **205**. For example, the print media will rotate until an edge or side of the print media substantially abuts against the registration wall **205** thereby causing the print media to substantially align against the registration wall **205**. In other words, when the first belt **210** is traveling at a speed less than the second belt **215**, the print media is steered towards the registration wall **205** until the edge of the print media is substantially aligned against the registration wall **205** and, continues to move along the media path **B**.

[0021] By configuring a plurality of belts such as the first and second belts **210**, **215** to travel at different relative speeds, the print media can be caused to rotate towards the slower belt. The slower belt (e.g., the first belt **210**) creates drag on a portion of the print media relative to a portion of the print media in contact with the faster belt (e.g., the second belt **215**). A percentage difference between the speed of the first belt **210** and the second belt **215** can be proportional to a percentage difference between the first diameter portion **235** of the drive shaft **230** and the second diameter portion **240** of the drive shaft **230**, respectively. For example, if the first diameter portion **235** is 5% less than the second diameter portion **240**, then the speed of the first belt **210** would be 5% less than the speed of the second belt **215**. In one embodiment, the first diameter portion **235** of the drive shaft **230** is between about 1%

and about 5% less than the second diameter portion **240** of the drive shaft **230**. Of course, other desired percentage ratios can be used.

[0022] To support the first and second belts **210**, **215**, the media registration mechanism **200** can include a first idler shaft **245** and a second idler shaft **250**. In one embodiment, the first idler shaft **245** is positioned at one end of the first and second belts **210**, **215** and the second idler shaft **250** is positioned at the other end of the first and second belts **210**, **215**. The drive shaft **230** can be positioned between the first and second idler shafts **245**, **250**. Of course, other configurations of the shafts **230**, **245**, **250** can be used as well as different numbers of shafts. In one embodiment, the first idler shaft **245** can include a first bearing **255** and a second bearing **260**. The second idler shaft **250** can include a third bearing **265** and a fourth bearing **270**. For example, the first belt **210** can be configured to be supported by the first bearing **255** and the third bearing **265**, while the second belt **215** can be configured to be supported by the second bearing **260** and the fourth bearing **270**.

[0023] Illustrated in **Figure 3** is a top view of another embodiment of a media registration mechanism **300**. Media registration mechanism **300** is similar in structure to and operates in a similar manner as media registration mechanism **200** illustrated in **Figure 2**. However, the media registration mechanism **300** includes a third media carrier such as a third belt **305**. Of course, it will be appreciated that any number of media carriers can be configured to carry the print media as described above. In one embodiment, the third belt **305** can be spaced a greater distance away from the registration wall **205** than the second belt **215**. Also, the third belt **305** can be positioned substantially parallel to the first and second belts **210** and the registration wall **205**.

[0024] The third belt **305** can be configured to engage print media and simultaneously move it in a linear direction along the media path **B** at a third speed. In one embodiment, the third speed of the third belt **305**, represented by arrow **E** (which is longer than arrows **C** and **D** to illustrate the difference in speeds), is greater than the second speed of the second belt **215**. Hence, the speed of each belt increases as the distance between each belt and the registration wall **205** increases. In this embodiment, upon concurrently engaging the print media, the first belt **210** moving at the first speed, the second belt **215** simultaneously moving at the second speed, and the third belt **305** simultaneously moving at the third speed causes the print media to rotate towards the registration wall **205**.

[0025] To drive the first, second, and third belts **210, 215, 305** at different relative speeds, the media registration mechanism **300** may further include drive means coupled to the first, second, and third belts **210, 215, 305**, respectively. In one embodiment, the drive means includes a drive mechanism **310** that is similar in structure to, and operates in a similar manner as, the drive mechanism **220** illustrated in **Figure 2**. However, the drive shaft **230** of the drive mechanism **310** includes a third diameter portion **315**. The third diameter portion **315** of the drive shaft **230** is greater than the second diameter portion **240**. In another embodiment, the drive means may include separate motors to independently drive each belt at a different speed. It will be appreciated that other types of drive means may be used including any mechanical, electromechanical, electromagnetic components, or combinations thereof to drive the first, second, and third belts **210, 215, 305** at different speeds.

[0026] To transfer rotational movement of the drive shaft **230** to the third belt **305**, the third diameter portion **315** of the drive shaft **230** is drivingly engaged with the third belt **305**. Because of the difference in diameters between the first, second, and third diameter portions **235, 240, 315**, respectively, of the drive shaft **230**, the drive shaft **230** can be driven at a single angular velocity, while the first, second, and third belts **210, 215, 305** travel at different linear velocities. Thus, when the drive shaft **230** is rotated, the third belt **305** travels at the third speed, which is greater than the second speed of the second belt **215**. As a sheet of print media comes into contact with the first, second, and third belts **210, 215, 305**, the difference in speeds causes the print media to rotate and move towards the registration wall **205** until the edge or side of the print media substantially abuts against the registration wall **205** thereby causing the print media to substantially align against the registration wall **205**.

[0027] With further reference to **Figure 3**, the media registration mechanism **300** can further include a fifth bearing **320** disposed on the first idler shaft **245** and a sixth bearing **325** disposed on the second idler shaft **250** to support the third belt **305**. Of course, any number of bearings can be used.

[0028] Illustrated in **Figure 4** is one embodiment of a methodology **400** associated with registering print media within an image forming device. The illustrated elements denote "processing blocks" and represent functions and/or actions taken for registering print media. In one embodiment, the processing blocks may represent software instructions or groups of instructions that cause a computer or processor to perform an action(s) and/or to make



decisions that control another device or machine to perform the processing. It will be appreciated the methodology may involve dynamic and flexible processes such that the illustrated blocks can be performed in other sequences different than the one shown and/or blocks may be combined or, separated into multiple components. The foregoing applies to all methodologies described herein.

[0029] With reference to **Figure 4**, the methodology **400** includes moving print media along a media path along a registration wall (block **405**). Portions of a sheet of print media are then moved along the media path by multiple belts configured to be driven at different speeds relative to the registration wall (block **410**). For example, portions of the print media that are closer to the registration wall are moved at slower speeds than portions farther away from the registration wall. For example, if using multiple belts to carry the print media, a belt positioned closer to the registration wall would be configured to be driven at a slower speed than a belt positioned farther away from the registration wall. In other words, the speed of each belt increases as the belt is further spaced from the registration wall.

[0030] One effect of simultaneously driving multiple belts at different speeds relative to the registration wall is that the print media will rotate towards the registration wall while still moving along the media path. This causes the print media to be steered towards the registration wall until an edge of the print media is substantially aligned against the registration wall while simultaneously moving the print media along a linear media path (block **415**). Optionally, the print media may be advanced to an image forming mechanism after the print media has been registered.

[0031] Illustrated in **Figure 5** is another embodiment of a methodology associated with moving print media along a media path in an image forming device. With reference to **Figure 5**, one process **500** involves moving print media along a media path in an image forming device that includes an alignment wall positioned along a portion of the media path and is substantially parallel to the media path. The process **500** includes moving a first portion of the print media along the media path at a first speed (block **505**). Simultaneously, a second portion of the print media is moved along the media path at a second speed that is different from the first speed (block **510**). An effect of simultaneously moving the first and second portions of the print media at different speeds is that the print media will rotate towards the alignment wall, while still moving the print media along the media path. The

rotation of the print media causes a side edge of the print media to substantially align against the alignment wall. In another embodiment, the process 500 may include simultaneously moving at least a third portion of the print media along the media path at a third speed different from the first and second speeds.

[0032] Illustrated in **Figures 6A-6E** is one embodiment of a media registration sequence using, for example, the media registration mechanism 300 described above and illustrated in **Figure 3**. As previously mentioned, the media registration mechanism 300 includes the registration wall 205 and the first, second, and third belts 210, 215, 305 (hereinafter collectively referred to as “the belts”) configured to travel at different speeds. For example, the third belt 305 is traveling at a speed greater than the second belt 215, which is traveling at a speed greater than the first belt 210. As shown in **Figure 6A**, a sheet of print media 605, having a leading edge 610, a side edge 615, and a trailing edge 620, is carried along a media path **B**. In one embodiment, the print media 605 is oriented such that the leading edge 610 of the print media 605 is substantially perpendicular to the registration wall 205 and the side edge 615 is substantially parallel to the registration wall 205, but may be spaced a distance away from the registration wall 205.

[0033] As shown in **Figure 6B**, once the print media 605 comes into contact with the belts, the belts engage different portions of the print media 605 and simultaneously move the different portions of the print media 605 at different speeds along the media path **B**. The speeds of the belts decrease for a belt positioned closer to the registration wall 205. One effect of simultaneously moving the different portions of the print media 605 at different speeds causes the print media 605 to rotate towards the registration wall 205, in the direction represented by arrow **F**, while still moving along the media path **B**.

[0034] As shown in **Figure 6C**, the print media 605 continues to rotate until one corner 625 of the print media 605 (i.e., meeting of the leading edge 610 and the side edge 615 of the print media 605) comes into contact with the registration wall 205. As shown in **Figure 6D**, once the corner 625 of the print media 605 comes into contact with the registration wall 205, the belts continue to move and try to rotate the print media 605 thereby creating additional friction between the belts and the print media 605. The friction between the belts and the print media 605 creates a moment, represented by arrow **G**, that is induced about the point of contact with the registration wall 205. The moment causes the trailing edge 620 of the print

media 605 to rotate towards the registration wall 205. As shown in Figure 6E, the print media rotates towards the registration wall 205 until the side edge 615 of the print media 605 is in contact with and is substantially aligned against the registration wall 205. Additional sheets of print media would also be similarly aligned against the registration wall 205.

[0035] While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.